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# A Description of Economic Changes in Commercial Salmon Fisheries in a Region of Mixed Subsistence and Market Economies

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**ABSTRACT.** Commercial salmon fisheries in the Arctic-Yukon-Kuskokwim (AYK) region of Alaska generally provide a cash supplement to the subsistence way of life of the rural residents, who make up the bulk of the commercial fishers. Changes have occurred in commercial salmon fishery sales and exvessel values in the region during the period 1976–97. While commercial sales of chum salmon have declined in recent years, chinook salmon sales have been more stable, and those of coho salmon were on an increasing trend until the weak return in 1997. Price drops have been most pronounced for chum salmon. These changes have brought shifts in composition of commercial salmon fishery exvessel values. Exvessel value grew from \$4.4 million in 1976 to relatively stable levels during the 1980s and early 1990s, except for a record value of \$29.2 million in 1988; values then declined in the mid 1990s to only \$7.5 million in 1997. The 1993–97 exvessel values, when adjusted for inflation, are the lowest since 1976. It is not known whether exvessel values will rebound, making the current downturn temporary, or whether the declines will persist. However, impacts of supply on a broader scale pose a serious problem for the commercial salmon fisheries in this remote region of Alaska, where the areas with the largest commercial salmon fisheries also have the lowest per capita incomes in the state. World supply trends for salmon are a supply-side factor in these economic changes. Impacts to the fishers at the local level are described in practical terms.

**Key words:** salmon, commercial sales, exvessel values, mixed subsistence-market economy, Alaska, Arctic-Yukon-Kuskokwim region

**RÉSUMÉ.** Les pêcheries de saumon commerciales situées dans la région alaskienne Arctique-Yukon-Kuskokwim (AYK) constituent en général un apport financier supplémentaire au mode de vie de subsistance des résidents ruraux, qui forment la majorité des pêcheurs commerciaux. Au cours de la période allant de 1976 à 1997, il y a eu dans la région des changements dans les ventes de la pêche commerciale au saumon et les valeurs des débarquements. Tandis que les ventes commerciales du saumon kéta ont baissé au cours des dernières années, les ventes du saumon quinnat se sont révélées plus stables, et celles du saumon coho ont été à la hausse jusqu'au faible rendement de 1997. La chute des prix a été la plus forte pour le saumon kéta. Ces changements ont amené des modifications dans la composition des valeurs des débarquements. Ces dernières ont augmenté des 4,4 millions de dollars qu'elles étaient en 1976 pour atteindre des niveaux relativement stables durant les années 80 et au début des années 90, sauf pour des valeurs records de 29,2 millions de dollars en 1988; les valeurs ont ensuite baissé au milieu des années 1990 pour n'atteindre que 7,5 millions de dollars en 1997. Si l'on tient compte de l'inflation, les valeurs des débarquements de 1993 à 1997 sont les plus basses depuis 1976. On ne sait pas si les valeurs des débarquements vont remonter, ce qui ferait du fléchissement actuel un phénomène temporaire, ou si les déclin vont se poursuivre. Il reste que, à grande échelle, les retombées de l'approvisionnement posent un grave problème à l'industrie de la pêche commerciale au saumon dans cette région reculée de l'Alaska, où les zones qui possèdent les plus grandes pêcheries de saumon commerciales sont aussi celles où le revenu par habitant est le plus faible de l'État. Les tendances dans l'approvisionnement mondial en saumon constituent un facteur sur le plan de l'offre dans ces changements économiques. On décrit en termes pratiques les retombées pour les pêcheurs au niveau local.

**Mots clés:** saumon, ventes commerciales, valeurs des débarquements, économie mixte de subsistance et de marché, Alaska, région Arctique-Yukon-Kuskokwim

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## INTRODUCTION

The Arctic-Yukon-Kuskokwim (AYK) region encompasses over 70% of the land area of Alaska (Fig. 1); it is roughly equivalent to the combined land areas of Washington, Oregon, Idaho, and California. The region includes the vast drainages of the Yukon River, the Kuskokwim River,

Norton Sound, and Kotzebue Sound and is sparsely populated, with many of the residents living in small rural communities located along rivers. Salmon stocks have been relied upon for food by indigenous peoples since their original immigration into the region. The subsistence salmon fisheries of the region are the largest of their kind in the world.

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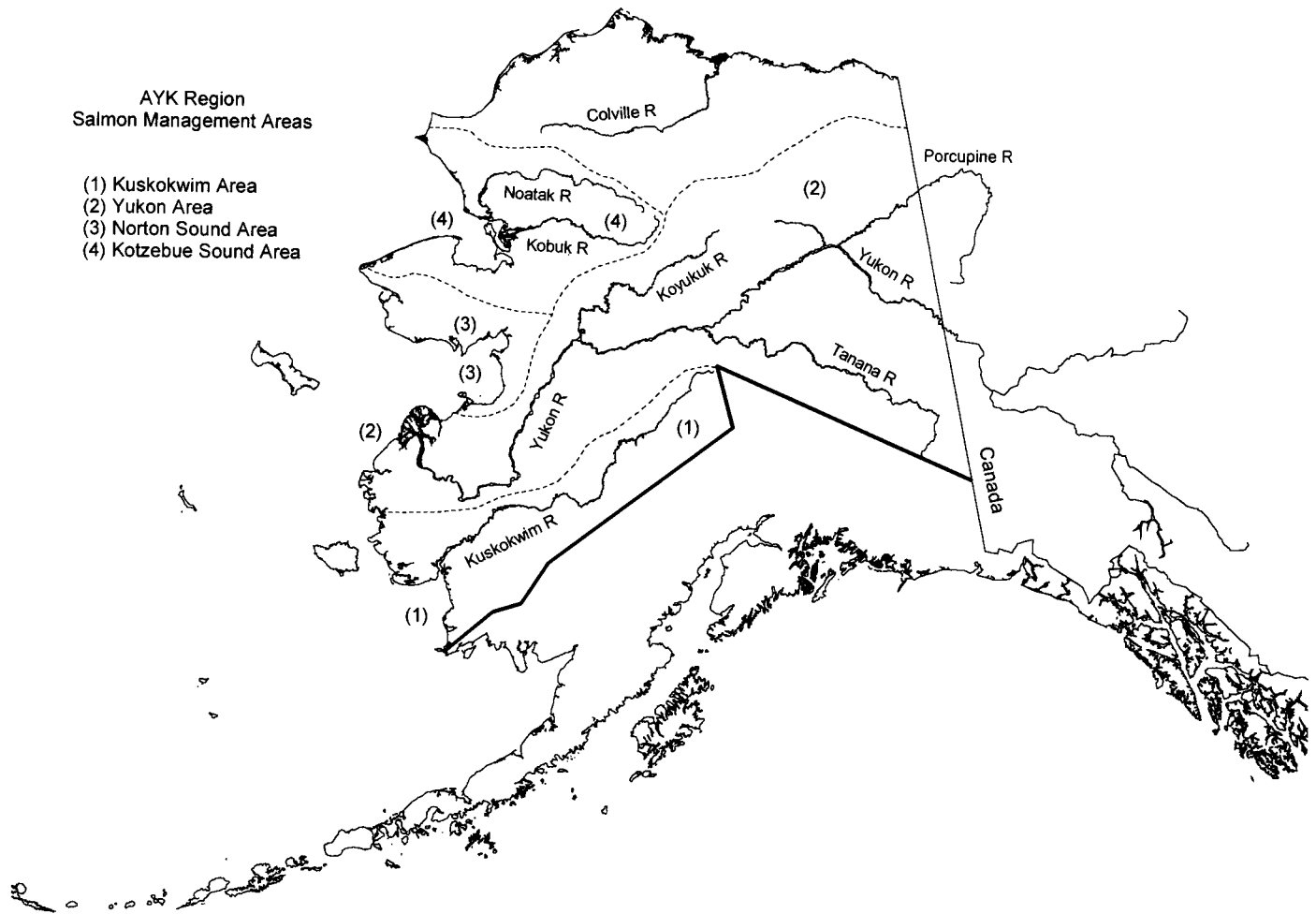


FIG. 1. Map of the Arctic-Yukon-Kuskokwim region.

The commercial salmon fisheries generally provide a cash supplement to the subsistence way of life of the rural residents, who make up the bulk of the commercial fishers. Wolfe and Walker (1987) describe the mixed subsistence-market economy of rural Alaska characteristic of the AYK region. In this mixed economy, subsistence harvests are a prominent part of the economy and social welfare of the people and provide a reliable economic base. Fishing and hunting are central activities in the communities. A family's subsistence production is augmented and supported by cash employment, commonly commercial fishing or related activity or by other wage employment. Money from the market sector of the economy supports subsistence activities.

Commercial fishers primarily use set or drift gillnets operated from outboard motorboats in the Yukon and Kuskokwim River drainages or at the mouths of rivers in the Kuskokwim Bay, Norton Sound, and Kotzebue Sound Districts. Fish wheels are also used in the upper Yukon River. With the implementation of limited entry in 1976, effort stabilized at about 800 commercial fishers in the Kuskokwim area, 820 in the Yukon River, 160 in Norton Sound, and 180 in Kotzebue Sound (Buklis, 1989);

however, these numbers have declined somewhat in more recent years. Most of the commercial salmon product is marketed fresh for domestic markets, or frozen for Japanese and domestic markets. Salmon roe is brined and marketed in Japan. Some specialty products, such as smoked salmon, are produced on a small scale for niche markets.

Exvessel value of commercial fisheries in the AYK region increased with the development of chum, *Oncorhynchus keta*, and coho, *O. kisutch*, salmon commercial fisheries (Buklis, 1989), but subsequent changes in market demand and fluctuations in resource availability have brought changes in commercial salmon sales and exvessel values. Market demand is affected by supply of salmon fishery products on a domestic and international level, including competition from expanded hatchery and farmed fish production, and by fishing, processing, and transportation costs in the region. Resource availability is a function of the status of the stocks, taking into account priority needs for spawning escapement (Buklis, 1993) and subsistence use and capability to assess the abundance of the runs promptly and accurately. While this paper focuses on describing changes in commercial salmon fishery sales

and exvessel values across this remote region of Alaska for the period 1976–97, context is provided for market demand relative to broader supply considerations.

The Division of Commercial Fisheries of the Alaska Department of Fish and Game (ADFG) manages the subsistence and commercial fisheries of the region, which is subdivided into the Kuskokwim (includes Kuskokwim River and Bay), Yukon (Yukon River drainage in Alaska), Norton Sound, and Kotzebue Sound areas. Fishery management follows management plans approved by the Alaska Board of Fisheries. All five Alaskan species of Pacific salmon occur in the region. Chum salmon are the most broadly distributed and abundant, whereas chinook, *O. tshawytscha*, and coho salmon are found primarily in the Kuskokwim, Yukon, and Norton Sound areas; sockeye salmon, *O. nerka*, are found primarily in the Kuskokwim area, and pink salmon, *O. gorbuscha*, are found primarily in the Kuskokwim, Yukon, and Norton Sound areas. With few exceptions, these are wild stocks of fish.

#### DATA SOURCES AND QUALIFICATIONS

Sources for sales and exvessel values (the price paid to fishers by processors) through 1996 include Burkey et al. (1998) for the Kuskokwim area, Bergstrom et al. (1997a) for the Yukon area, and Bue et al. (1997) for the Norton Sound and Kotzebue Sound areas. All information for 1997 is preliminary and was obtained from Burkey et al. (1997) for the Kuskokwim area, Bergstrom et al. (1997b) for the Yukon area, Bue and Lean (1997) for the Norton Sound area, and Lingnau and Lean (1997) for the Kotzebue Sound area. For all years, sales and exvessel value data are based upon compilation of information from copies of sales receipts issued to fishers by processors. Units of measure used in this paper are the units of measure common in the industry. The exvessel values reported here and in the source material did not include some retroactive payments, but this was not considered problematic for the purposes of this descriptive analysis.

This paper presents commercial sales information for the AYK region. That is, not all salmon caught by commercial fishers are sold; instead, some fish are taken home for subsistence use, and where roe is the product sold, male fish and roe-excised females may also be used for subsistence. In the AYK region, salmon roe sales occur almost exclusively in the upper Yukon River drainage. Yukon River salmon roe was not differentially recorded as chinook or coho salmon prior to 1990 but was instead included with chum salmon roe sales; therefore, sales totals for chum salmon in earlier years include small amounts of chinook and coho salmon roe. Both summer and fall runs of chum salmon occur in the Yukon River (Buklis and Barton, 1984), and data are presented separately for the two runs. Information presented here for the Yukon River does not include the fishery in the Canadian portion of the drainage (JTC, 1997).

Anchorage Consumer Price Index (CPI) data were obtained from the Alaska Department of Labor (N. Fried, Research and Analysis Section, Anchorage, pers. comm. 1998). Exvessel value data presented here are not adjusted for inflation using the Anchorage CPI unless specifically noted.

World salmon commercial supply data since 1980 were obtained from the Salmon Market Information Service (G. Knapp, University of Alaska Anchorage, Institute of Social and Economic Research, pers. comm. 1998). Data for 1996 and 1997 are estimates. For wild and hatchery production, data consist of chinook, coho, sockeye, chum, pink, and cherry (*O. masou*) salmon commercially harvested in Alaska, other North American fisheries, Japan, and Russia. Data are in round weight expressed in metric tons. Roe is typically removed from salmon by buyer-processors after purchase of fish in the round. Thus, these data do not include estimates of fish harvested to produce roe in those instances where roe is removed by fishers and sold apart from the carcasses, as in the upper Yukon River. Alaska chum salmon production was further broken down into wild and hatchery components by applying percentages from ADFG data (M. McNair, Division of Commercial Fisheries, Juneau, pers. comm. 1998). For farmed salmon production, data consist of Atlantic salmon (*Salmo salar*), chinook, coho (and in one year, a small amount of cherry salmon) produced in Australia, Canada, Chile, the Faroe Islands, Iceland, Ireland, Japan, New Zealand, Norway, the United Kingdom, the United States (not allowed in Alaska), and from other unidentified sources.

#### FISHERY ANALYSES

##### *Commercial Sales*

Chum, chinook, and coho salmon predominate the commercial salmon fishery sales in the AYK region. Commercial chum salmon sales for the region have ranged from 317 000 fish in 1993 to 3.2 million in 1988; peaks occurred in the early and late 1980s, and several lows have occurred in the 1990s to date, most notably in 1993 and 1997 (Fig. 2). By five-year periods, regionwide commercial sales of chum salmon averaged 1.7 million fish annually for 1976–80, 1.9 million for 1981–85 and for 1986–90, and 1.0 million for 1991–95. The Yukon River, with the summer and fall chum salmon runs taken together, has typically accounted for more of these sales than has any other area of the region. In 1993, a broad-based chum salmon run failure affected most chum salmon stocks and fisheries in the AYK region (Buklis, 1994).

Commercial chinook salmon sales for the region have ranged from 118 000 fish in 1996 to 252 000 in 1983. Sales peaked in the early 1980s, followed by a somewhat lower level that is more stable than the pattern for chum salmon (Fig. 2). By five-year periods regionwide commercial sales of chinook salmon averaged 174 000 fish annually

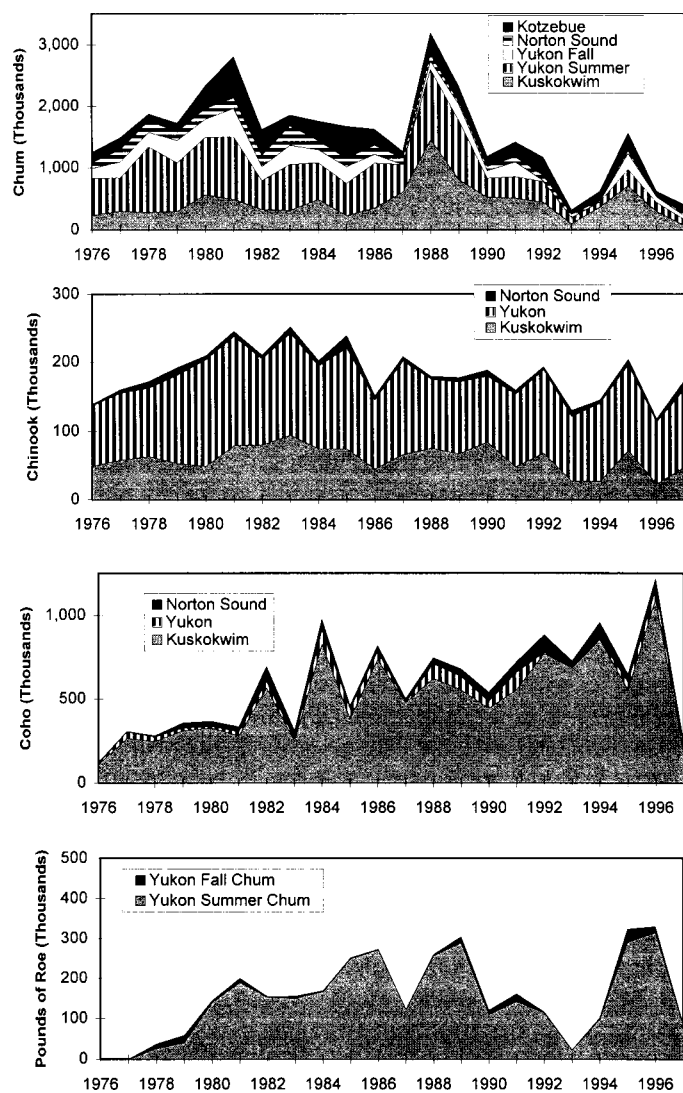


FIG. 2. Annual commercial sales of chum, chinook, and coho salmon by area in the AYK region, and of Yukon River chum salmon roe, 1976–97.

for 1976–80, 230 000 for 1981–85, 181 000 for 1986–90, and 166 000 for 1991–95. The Yukon River has consistently accounted for more of these sales than has any other area of the region.

AYK coho salmon commercial sales have ranged from 124 000 fish in 1976 to 1.2 million in 1996, and were on an increasing trend until the weak return in 1997 (Fig. 2). By five-year periods regionwide commercial sales of coho salmon averaged 287 000 fish annually for 1976–80, 556 000 for 1981–85, 658 000 for 1986–90, and 789 000 for 1991–95. The Kuskokwim area consistently accounts for most of the coho salmon sales in the AYK region.

Summer chum salmon commercial roe sales developed in the upper Yukon River beginning in the late 1970s. Commercial roe sales have ranged from 23 000 lb in 1993 to 315 000 lb in 1996, when sales rebounded after reduced volume in the early 1990s (Fig. 2). This rebound was partially attributed to the establishment of a new terminal fishery by the Alaska Board of Fisheries within the Anvik

TABLE 1. Exvessel values (in thousands of dollars, unadjusted for inflation) of commercial salmon sales (fish in the round and roe combined) for all species combined, in the AYK region, by management area, 1976–97.

Year	Kuskokwim River & Bay	Yukon River	Norton Sound	Kotzebue Sound	AYK Regional Total
1976	1401	2131	280	580	4392
1977	3910	4268	529	1034	9741
1978	2343	5740	813	575	9471
1979	3327	7171	877	990	12365
1980	2733	5790	578	1447	10548
1981	3613	10021	763	3247	17644
1982	4273	6677	998	1962	13910
1983	2674	6964	1033	421	11092
1984	5781	5670	721	1149	13321
1985	3256	7020	827	2137	13240
1986	4755	6261	539	931	12486
1987	6385	7202	500	515	14602
1988	12538	13380	744	2581	29243
1989	5188	10179	275	614	16256
1990	4878	6517	494	438	12327
1991	3959	9552	424	438	14373
1992	5317	11332	443	534	17626
1993	3942	5428	316	235	9921
1994	5150	4788	862	234	11034
1995	4239	7154	356	316	12065
1996	2901	4798	340	56	8095
1997	1060	5889	363	188	7500
Avg 76–80	2743	5020	615	925	9303
Avg 81–85	3919	7270	868	1783	13841
Avg 86–90	6749	8708	510	1016	16983
Avg 91–95	4521	7651	480	351	13004

River, a tributary of the Yukon River that supports the largest chum salmon escapements in the region, and which is typically well above its minimum biological escapement goal. However, roe sales decreased sharply in 1997, when supply competition brought a sudden drop in price and buyer interest.

#### Exvessel Values

Total exvessel value of salmon commercial fishery sales in the AYK region grew from \$4.4 million in 1976 to relatively stable levels during the 1980s and early 1990s, except for a sharp spike and record value in 1988 of \$29.2 million. This spike was followed in the mid 1990s by a decline in values to only \$7.5 million in 1997 (Table 1). Chum salmon typically accounted for the largest portion of the regional salmon exvessel value, but that contribution has dropped substantially in recent years, both in absolute amount and in proportion (Fig. 3). Chinook and coho salmon exvessel values have been more stable, except for the sharp drop in coho salmon sales in 1997. Sockeye and pink salmon have contributed much less to the regional salmon exvessel value, but with the drop in chum salmon value, sockeye salmon now compose a greater proportion of the total than in the past. The Yukon and Kuskokwim areas have consistently produced the bulk of the regional salmon exvessel value, and this is more

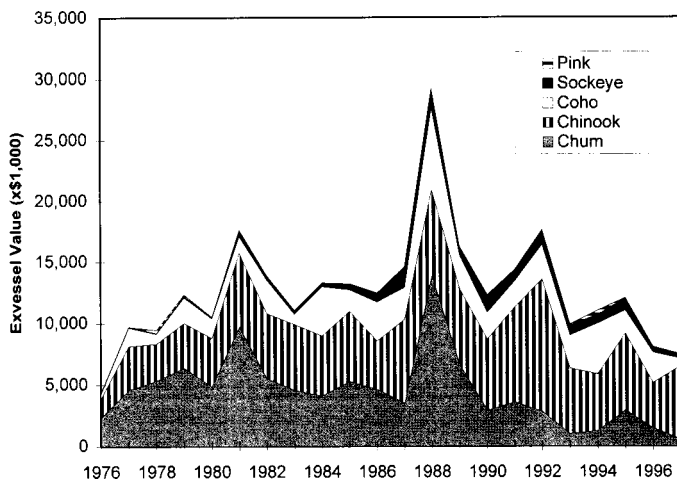


FIG. 3. Annual exvessel value (unadjusted for inflation) of commercial salmon sales (fish in the round and roe combined) in the AYK region by species, 1976–97.

evident in recent years with the decline in exvessel value for the Norton Sound and Kotzebue Sound salmon fisheries (Table 1).

With overall exvessel values for the region's commercial salmon fisheries declining, values by species and area have shifted, as evident in the species/area 5-year averages depicted in Figure 4. The Yukon River chinook salmon fishery has consistently accounted for the largest exvessel value of any of the species/area commercial salmon fisheries in the region, growing from an average of 25% for the 1976–80 period to 50% for the 1991–95 period. Conversely, the Yukon River summer chum salmon commercial fishery (fish and roe sales combined) declined in value from an average contribution of 20% to 7% for these same two periods, and its exvessel rank dropped from second to third as it was supplanted by the Kuskokwim area coho salmon fishery, which accounted for 19% of the total in the 1991–95 period.

Yukon River fall chum salmon and Kotzebue Sound chum salmon commercial fisheries, which composed 9% and 10%, respectively, of the regional total exvessel value in the 1976–80 period, both dropped to less than 3% for the 1991–95 period. However, the lack of a fall season commercial fishery on the Yukon River in some recent years, due to conservative management and stock rebuilding, contributed to the drop for Yukon River fall chum salmon. Kuskokwim area sockeye salmon sales for the 1991–95 period were tied with Yukon River summer chum salmon sales for third ranking in the region, each contributing 7% of the exvessel value.

For the most recent year, 1997, with the continued low value of chum salmon sales, and the anomalous drop in coho salmon sales, the Yukon River chinook salmon fishery alone accounted for a remarkable 74% of the total salmon exvessel value in the region.

The 1993–97 exvessel values in actual dollars for all species combined were well below the 1988 peak value, and even below that of most prior years (Fig. 5). However,

when exvessel value is adjusted for inflation using the Anchorage CPI, this decline becomes even more pronounced, showing the 1993–97 values to be the lowest since 1976, and the 1996 and 1997 values to be below the 1976 level.

Exvessel values vary with sales volume and unit price. Detailed information on price per lb for salmon in the AYK region since 1976 is provided in Table 2. Trends in price per lb for the largest of the chum, chinook, and coho salmon fisheries in the region are depicted in Figure 6. Prices for lower Yukon River summer chum salmon and Kuskokwim area coho salmon ranged along a general plateau until relatively sharp drops to lower levels in recent years. Prices for upper Yukon River summer chum salmon roe and for lower Yukon River chinook salmon demonstrated a pattern of more protracted increase, followed by a drop to more intermediate levels in recent years. However, price dropped sharply in 1997 for upper Yukon River summer chum salmon roe, while it rebounded somewhat for lower Yukon River chinook salmon.

Accounting for the reduced purchasing power of the dollar caused by inflation over this two-decade period provides further perspective. Converted to inflation-adjusted dollars using the Anchorage CPI, the prices paid for lower Yukon River summer chum salmon in 1994–97, for upper Yukon River summer chum salmon roe in 1997, and for Kuskokwim area coho salmon in 1995–97, were the lowest in the entire study period for these products. Of the examples detailed here, the price drop on a relative basis is most pronounced for lower Yukon River summer chum salmon. In 1976 those fish were \$0.24/lb, compared to \$0.09/lb in 1996 and \$0.10/lb in 1997. When discounted for inflation, the 1996 and 1997 prices equate to \$0.04/lb in 1976 dollars, which means a sixfold price difference. Prices for lower Yukon River chinook salmon, on the other hand, have kept pace with inflation.

### World Salmon Supply

The worldwide supply of salmon has expanded rapidly and substantially (Fig. 7). Total supply from all sources combined has increased by a factor of 2.7, from 561 000 metric tons in 1980 to 1 529 000 metric tons in 1997. Wild and hatchery production for all species combined, while showing some increase, has been relatively stable during this period as compared to the rapid expansion of farmed salmon supply. Farmed salmon supply, consisting mostly of Atlantic salmon, increased from 59 000 metric tons in 1985 to 709 000 metric tons in 1997, a twelvefold increase. Farmed salmon now accounts for nearly half of the total world supply.

Data for chum salmon, a species that is not commercially farmed, indicate that world supply has increased overall, more than doubling from 167 000 metric tons in 1980 to 357 000 metric tons in 1997 (Fig. 7). Japan has consistently accounted for the majority of world chum salmon supply, with almost all Japanese harvest coming

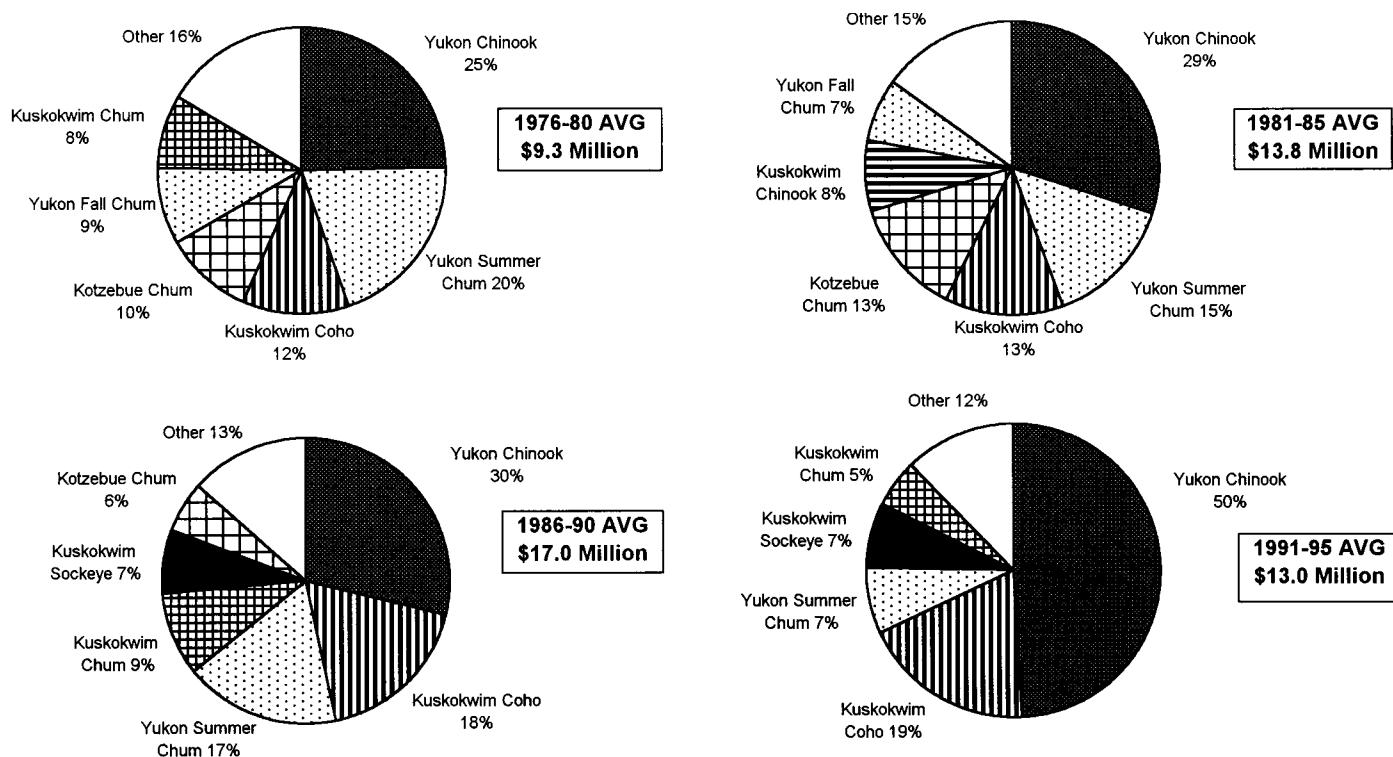


FIG. 4. Percent contribution, by species/area commercial fishery (sales of fish and roe combined), to the total AYK salmon commercial fishery exvessel value, for four five-year periods, 1976–95.

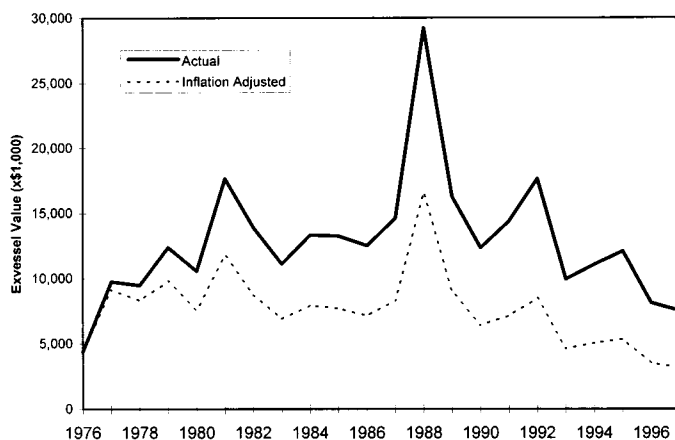


FIG. 5. Annual exvessel value of commercial salmon sales (fish and roe combined) in the AYK region, all species and areas combined, 1976–97, in actual dollars and inflation-adjusted dollars (using the Anchorage Consumer Price Index relative to 1976).

from hatchery production. As Japanese hatchery production expanded, Japanese chum salmon harvest increased, from 97 000 metric tons in 1980 to 266 000 metric tons in 1997. This represents an increase in share of world chum salmon supply from 58% to 75%. Chum salmon supply from Alaska was relatively stable from 1980 through 1993, but has been increasing since then, peaking in 1996 before dropping off somewhat in 1997. Alaskan production was 33 000 metric tons in 1980, 38 000 metric tons in 1993, and 87 000 metric tons in 1996. However, new chum salmon hatchery production in Alaska has caused a substantial shift in the source of supply. Hatchery production, which accounted for less than 1% of chum salmon supply

from Alaska in 1980, increased to 48% in 1993 and 67% in 1996.

Data for chinook and coho salmon, species that are commercially farmed, indicate that the world supply of chinook from all sources combined has been relatively stable, while the supply of coho has increased (Fig. 7). Total chinook salmon supply from all sources combined was 23 000 metric tons in 1980 and 27 000 metric tons in 1997. However, farmed product has been accounting for an increasing percentage of the world chinook supply, growing from 1% in 1985 to 56% in 1997. Total coho salmon supply from all sources combined was 29 000 metric tons in 1980 and increased to 105 000 metric tons in 1997. Farmed product accounted for 19% of world coho supply in 1985, but had increased to an 86% share by 1997.

## DISCUSSION

Few income employment opportunities are available in many of the rural communities characteristic of the AYK region, and low annual per capita incomes are typical. The many local commercial salmon fisheries in the region, although most are small by statewide standards, provide cash income to supplement the subsistence way of life. Commercial fishery sales are a result of both market demand and resource availability. Their combined effect in recent years has resulted in a substantial downturn in the region's commercial salmon fishery, as reflected by decreased exvessel values. There is a ripple effect to the

TABLE 2. Average price per pound (in dollars, unadjusted for inflation) paid to fishers for commercial sales of salmon in the round (unless noted as roe) in the AYK region by management area and year, 1976–97.<sup>1</sup>

Year	Chum								Chinook				Coho				Sockeye	Pink	
	1	2S	2F	3S	3SR	3F	4	5	1	2	3	4	1	2	3	4	1	1	4
1976	0.27	0.24	0.24	0.19		0.16	0.30	0.41	0.64	0.51	0.74	0.50	0.40	0.27	0.19	0.32	0.43	0.25	0.17
1977	0.45	0.40	0.45	0.27	2.66	0.22	0.30	0.56	1.15	0.85	1.37	0.65	0.65	0.50	0.27	0.40	0.45	0.25	0.16
1978	0.32	0.45	0.47	0.24		0.25	0.30	0.57	0.50	0.90	0.87	0.65	0.40	0.60	0.24	0.35	0.49	0.12	0.20
1979	0.37	0.52	0.68	0.25	3.00	0.29	0.41	0.80	0.66	1.09	1.00	0.88	0.75	0.80	0.25	0.66	0.53	0.11	0.16
1980	0.24	0.20	0.28	0.23	2.50	0.27	0.23	0.46	0.47	1.04	0.85	0.74	0.64	0.36	0.29	0.63	0.31	0.12	0.07
1981	0.23	0.40	0.55	0.20	3.00	0.35	0.26	0.53	0.84	1.20	1.00	1.25	0.63	0.60	0.35	0.62	0.61	0.11	0.13
1982	0.22	0.40	0.55	0.18	2.75	0.28	0.32	0.51	0.82	1.41	1.02	1.25	0.53	0.69	0.37	0.57	0.41	0.05	0.12
1983	0.33	0.34	0.34	0.16	1.66	0.19	0.28	0.25	0.54	1.40	1.08	1.13	0.39	0.35	0.31	0.39	0.51	0.05	0.11
1984	0.28	0.26	0.32	0.23	1.78	0.26	0.24	0.44	0.89	1.50	0.95	1.20	0.55	0.50	0.24	0.45	0.52	0.07	0.11
1985	0.25	0.35	0.47	0.23	1.94	0.25	0.31	0.47	0.71	1.50	0.86	1.08	0.51	0.53	0.33	0.48	0.59	0.05	0.20
1986	0.25	0.38	0.49	0.22	2.08	0.14	0.27	0.41	0.80	1.63	0.89	0.88	0.60	0.71	0.21	0.52	0.70	0.05	0.15
1987	0.27	0.49		0.19	2.22		0.33	0.57	1.10	1.98	0.79	1.11	0.73			0.57	1.30	0.10	0.20
1988	0.40	0.66	1.01	0.23	4.33	0.32	0.39	0.85	1.30	2.97	1.04	1.26	1.25	1.38	0.37	1.13	1.42	0.15	0.19
1989	0.26	0.34	0.50	0.24	4.41	0.28	0.18	0.28	0.75	2.77	0.84	0.73	0.55	0.66	0.35	0.43	1.20	0.05	0.10
1990	0.26	0.24	0.45	0.11	4.41	0.29	0.23	0.31	0.56	2.84	0.72	1.01	0.62	0.66	0.34	0.50	1.05		0.12
1991	0.31	0.36	0.34	0.18	4.21	0.23	0.27	0.22	0.56	3.70	0.70	0.87	0.45	0.44	0.30	0.36	0.67		0.12
1992	0.32	0.27		0.30	4.53	0.39	0.22	0.22	0.66	4.12	0.91	0.66	0.45		0.39	0.33	0.90	0.06	0.16
1993	0.40	0.38		0.35	8.53		0.24	0.38	0.62	2.70	1.06	0.72	0.58			0.22	0.70	0.25	0.15
1994	0.21	0.21		0.20	3.77	0.16	0.29	0.20	0.51	2.07	0.92	1.02	0.57		0.48	0.52	0.53	0.08	0.15
1995	0.18	0.16	0.15	0.13	3.57	0.13	0.18	0.13	0.60	2.09	0.77	0.66	0.41	0.29	0.14	0.43	0.71	0.12	0.18
1996	0.11	0.09	0.10	0.07	3.05	0.13	0.08	0.09	0.26	1.95	0.95	0.54	0.25	0.26	0.09	0.28	0.40	0.12	0.10
1997	0.12	0.10	0.22	0.07	1.08	0.17	0.11	0.16	0.28	2.46	0.97	1.00	0.33	0.32	0.20	0.47	0.42	0.10	0.06

<sup>1</sup> Column notations are as follows: 1 = Kuskokwim River and Bay; 2 = Lower Yukon River; 3 = Upper Yukon River; 4 = Norton Sound; 5 = Kotzebue Sound; S = Summer Run; F = Fall Run; R = Roe.

subsistence way of life; i.e., boats, motors, and nets from commercial fishing are also used for subsistence fishing, and cash is needed to buy gas and maintain or replace worn equipment used in both the commercial and subsistence fisheries.

Although prices paid for salmon products in the region have dropped in recent years, the drop in the chum salmon market has been the most pronounced. An example may help to illustrate the point. The long-term average weight of summer chum salmon sold in the lower Yukon River commercial fishery since 1976 has been about 7 lb, whereas that of chinook salmon has been about 21 lb (Bergstrom et al., 1997a). This is a relationship of 3 summer chum to 1 chinook salmon by weight. The relationship by value, factoring in average price per lb paid in selected years, yields very different ratios. In 1976 the sale of 6 summer chum salmon roughly equaled the value of 1 chinook salmon. In 1988, the relationship was 14 to 1, and by 1996 it was 65 to 1. Recalling that chinook salmon price dropped during the recent period, the change in the value relationship between the two species underscores the drop in chum salmon price.

Two practical examples may serve to illustrate the impact to fishers. First, in the early 1980s, boat gas sold for about \$2.00 per gallon in the lower Yukon River (J. Austin, Bulk Fuel Distributor, St. Michael, pers. comm. 1996). Given salmon prices at the time, the sale of about 5 summer chum salmon provided enough cash to fill a 6-gallon gas tank. In 1996, with boat gas at about \$2.45 per gallon (J. Austin, pers. comm. 1996) and summer chum salmon selling for \$0.09/lb, about 23 summer chum salmon

had to be sold to fill that same tank. Second, a new 115-hp outboard motor retailed for about \$6200 in 1996 in the lower Yukon River (Alaska Commercial Company, Anchorage, pers. comm. 1996). The average per fisher gross income earned for the sale of chinook and summer chum salmon in the lower Yukon River in 1996 was about 10% short of affording that purchase, even disregarding taxes and overhead.

Comparing the 1981–85/1991–95 periods, exvessel values for the region as a whole averaged \$5.8/\$2.3 million for chum salmon (fish and roe combined), \$5.5/\$6.9 million for chinook salmon, and \$2.1/\$2.7 million for coho salmon. Given the broad distribution of the chum salmon stocks and associated commercial fisheries across the region, the substantial drop in the chum salmon component of the exvessel value has far-reaching effects.

Price drops and potential harvest not taken for market reasons point to supply outpacing demand. Therefore, world salmon supply data were examined to provide insight into the changes described here for the AYK region of Alaska. Rapid and substantial increases in supply have occurred in recent years. Most notable on a global scale are the increases in farmed salmon production and in hatchery production of chum salmon.

There is ongoing debate in Alaska as to whether competition from new chum salmon hatchery production in Alaska or expanded hatchery production in Japan is the primary cause of the market downturn for chum salmon and chum salmon roe in the AYK region. It is clear from the data that during the 1990s there has been a substantial shift in source of supply in Alaska from wild to hatchery

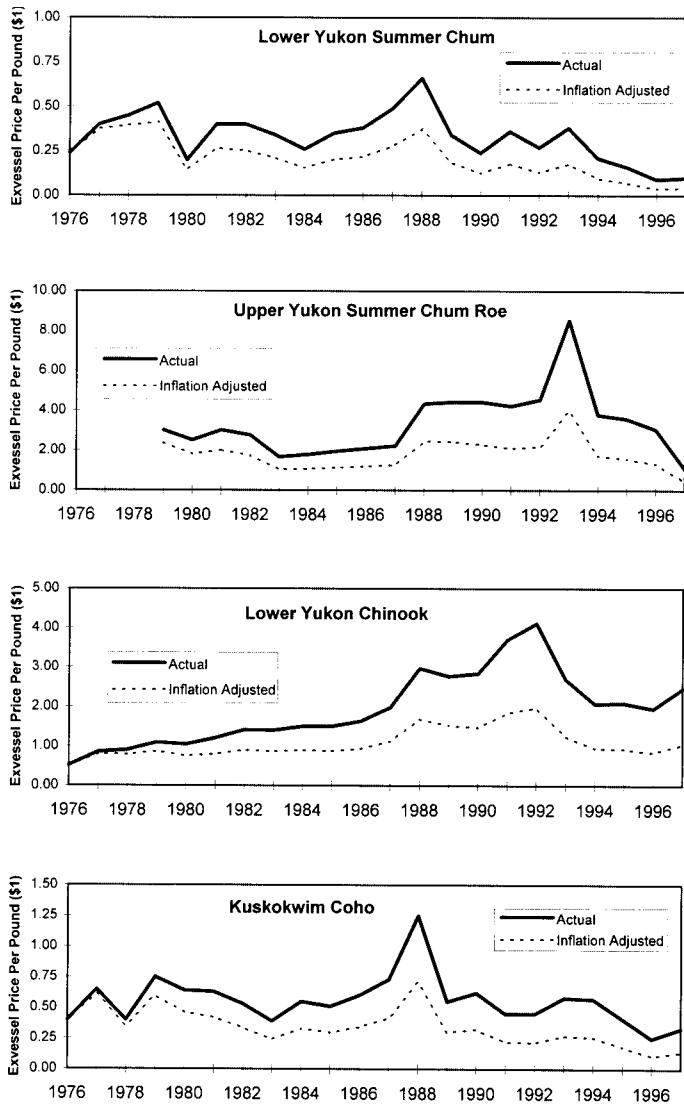


FIG. 6. Annual (1976–97) exvessel prices paid per pound for lower Yukon River summer chum salmon, upper Yukon River summer chum salmon roe, lower Yukon River chinook salmon, and Kuskokwim area coho salmon, in actual dollars and inflation-adjusted dollars (using the Anchorage Consumer Price Index relative to 1976).

production, and that this has been occurring at a time of substantial increase in the already dominant hatchery production of chum salmon in Japan. Wild and hatchery chum salmon production is available from Alaska during June to September, while Japanese hatchery production becomes available during October to December. Transportation costs to market from the remote fisheries in the AYK region and maturity of the fish in some locales pose a competitive disadvantage. Alternatives, such as selling of excised roe from upriver fisheries, attempt to overcome these disadvantages. However, roe is increasingly available on the market from domestic and Japanese hatchery returns. While the relative significance of the domestic and Japanese production on local chum salmon and chum salmon roe markets may be debated, it is clear that their combined effect has been a substantial drop in exvessel value in the AYK region of Alaska.

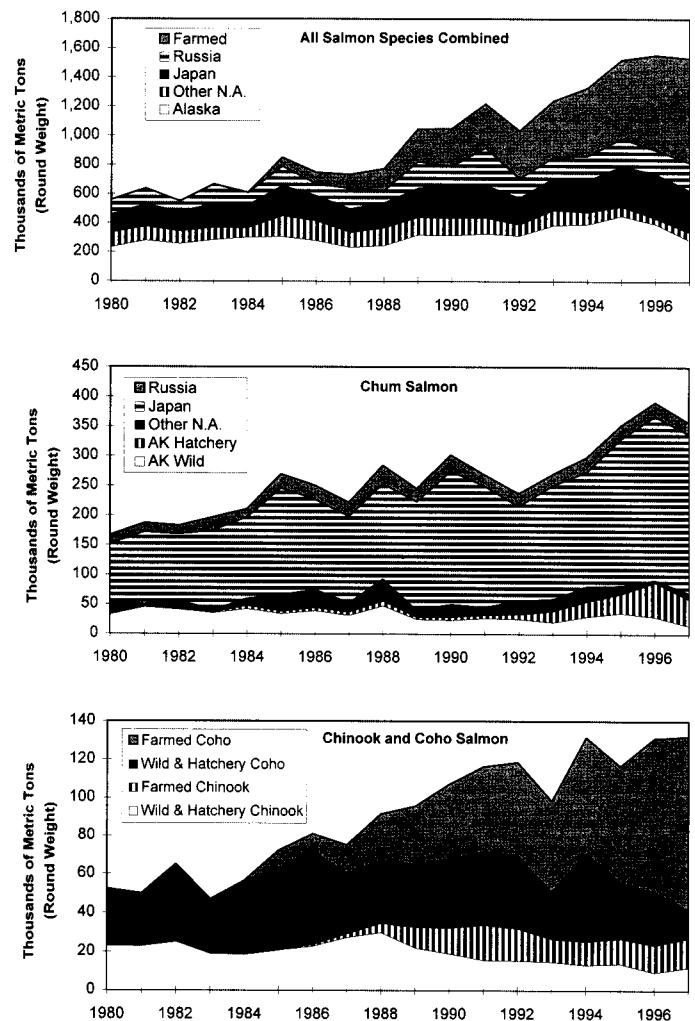


FIG. 7. Worldwide commercial supply of salmon, 1980–97, for all seven species combined, for chum salmon only, and for chinook and coho salmon only. Data include wild and hatchery production combined by geographic area, unless otherwise noted. Farmed salmon production is not broken down by geographic area.

It is not known whether exvessel values for salmon from the AYK region will rebound, making the current downturn temporary, or whether the declines will persist. For chum salmon and chum salmon roe product, given the competition within Alaska and from Japan due to expanded hatchery production, the outlook is not good unless specialty products or niche markets can be successfully developed. Such marketing efforts have been initiated for AYK chum salmon in recent years, but it is too soon to know their ultimate level of success. For chinook and coho salmon, supply is increasing from farmed product outside of Alaska, and this likely poses the most significant source of increased competition. Although Yukon River chinook salmon has its own market identity because of uniquely high oil content, other chinook supply from the AYK region and coho salmon do not have such a niche; they are therefore more vulnerable to competition from farmed product. It is unclear how expanded farmed supply in the future might affect market demand for even Yukon River



chinook salmon, the salmon fishery of highest value in the AYK region.

Large increases in world supply of salmon in recent years pose a serious problem for the commercial salmon fisheries in this remote region of Alaska. Areas with the largest commercial salmon fisheries in the AYK region are also areas with the lowest per capita incomes in the state. The lower Yukon River typically has the lowest average per capita income in Alaska: \$6500 in 1989, which was only 37% of the statewide average. Per capita income in the Kuskokwim area was only \$8800 in 1989, or 50% of the statewide average (Alaska Department of Labor Statistics, R. Wolfe, ADFG, Subsistence Division, Juneau, pers. comm. 1996). Given that during the 1991–95 period the Yukon River chinook salmon and Kuskokwim area coho salmon commercial fisheries represented, on average, 69% of the total salmon exvessel value for the region, significant downturns in market demand or resource availability for those fisheries could have serious additional impacts on the local economies.

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